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gently I was unable to find the nest. I am aware that there have been several nests found in eastern Massachusetts, though this must certainly be its most southern breeding range.

I have thought the species must leave us on their southern migration by the first of September, though I saw one specimen at Moosehead Lake, Maine, as late as the 1st of Oct., 1873, at which period the weather was quite cold, water freezing round our camp most every night.—RUTHVEN DEANE, *Cambridge, Mass.*

THE OLIVE-SIDED FLYCATCHER.—At the close of an article on *Contopus borealis*, which appeared in the December number of the NATURALIST (page 750), I made the inquiry "Has this species ever been obtained in Massachusetts before?" Since then I have ascertained that specimens of it have been collected in eastern Massachusetts by Mr. C. J. Maynard, Wm. Brewster, Esq. and others, and that it occasionally breeds within the state.

In addition to the note previously described, Mr. Nuttall said: "The female had a whistling, oft-repeated, whining call of *'pŭ 'pŭ*, then varied to *'pŭ 'pĭp*, and *'pĭp 'pŭ*, also at times *'pĭp 'pĭp 'pŭ*, *'pĭp 'pĭp 'pĭp*, *'pŭ 'pŭ 'pĭp*, or *'tŭ 'tŭ 'tŭ*, and *'tŭ 'tŭ*. The male, besides this note, had, at long intervals, a call of *seh 'phèbēē* or *'h 'phebéă*." It is such a difficult undertaking to represent accurately the note of a bird by means of letters, that no two persons describe that of the same species by the same characters, although when pronounced, the syllables generally give the same sound. Thus Mr. Nuttall's call of *'h 'phebéă* is undoubtedly the same as that described by myself as *O whéŏ*. His imitation of the note of the female bird is most excellent: I have heard it many times and omitted giving it only because I neglected to write it down while in the field, and it will never do to trust to memory for such matters.—C. HART MERRIAM.

MICROSCOPY.

ON THE STRUCTURE OF DIATOMS.—It is hoped that the publication of the following memoranda will serve the double purpose of elucidating the structure of the tests, and at the same time demonstrating the utility of microscopical objectives of exceptionally high powers. The uncertainty of the footing in this unstable and contested ground will necessitate many errors, and may serve as an excuse for them. So many competent microscopists have written upon this subject that the writer would fain be silent were it not for a firm belief in the superiority of the instrument he used, for this kind of investigation. In fact this excellent glass gives advanced work on almost every test tried, and fully justifies the confidence reposed in it. The observations recorded below, unless where otherwise stated, were made with a Tolles' $\frac{1}{50}$ immersion objective of 165° angle of aperture, and generally a Tolles' two inch eye-piece, giving an amplification of 2500 diameters.

Eupodiscus Argus.—My attention was especially called to this shell by having noticed the wide difference between the views of Mr. Henry J. Slack, Mr. Samuel Wells and Mr. Charles Stodder. My observations are corroborative of the idea of two plates as asserted by Messrs. Stodder and Wells. Using a $\frac{2}{3}$ objective with power of 340 times obtained by high eye-piece and extending draw-tube, and using a Lieberkühn, the outside or coarser markings on specimens mounted convex side uppermost are white with white cloud illumination. An erased space on one shell and the holes or depressions through which Slack's four large "spherules" are seen are now black. They, then, are not covered by the external "crust."

The slide was then turned over and the inside of the same specimen examined by the same method, and on the more favorable portions of it the finer net-work of the *inner plate* is also seen in white, the "spherules" being perfectly black. By this reflected light the "four spherules" are plainly seen to be dark openings in the white plate and the net-work is clearly traced across the areolæ in the outside plate. The diatom looks like a piece of coarse white netting laid over a finer piece.

Under the Tolles' $\frac{1}{50}$ and with transmitted light, whether central or oblique, it matters not, all portions of the surface of both the upper and the lower plates are found to be covered with, or composed of, a *still finer net-work* with irregular oval meshes like the two coarser ones.

The place in the shell above referred to, where the layers are erased, denuding an interior structureless "vail," gives an opportunity to observe the edges of the fractured layers. The broken edges of both plates bordering on the erasure show the jagging of this finest net structure. The arrangement of the finest areolæ is more regular near the margin of the diatom or appears so by reason of the simpler character of the structure in that part. They are easily seen with the $\frac{1}{50}$ on any part of every specimen studied, but are unusually distinct between the "four spherules" on the inner plate looking through the largest openings in the outer plate; or may be rendered still more distinct on shells with the concave side up. They are more difficult to be seen on the outside crust with the high powers used because of its greater opacity. Deductions from focal changes with reference to the various markings lying in different focal planes corroborate the conclusions above expressed.

The disks examined are on Möller's Probe-Platte and on a slide prepared by Mr. Wells.

Hyalodiscus subtilis Bailey.—On this beautiful little shell the "engine rulings" are readily seen with almost any illumination, and the inevitable concomitant of intersecting lines, whether real or illusory beading are displayed. When we use monochromatic light the whole scene is changed. The hyaline portion of the disk is instantly resolved into perfectly well defined hexagons, radiating from the central nucleus. The central part because of its greater depth and complexity is only resolved into irregularly shaped spaces of a more or less hexagonal form. Every one of the five beads usually seen represents the centre of an hexagonal plane exactly as in *Pleurosigma angulatum.*

The hexagons are well defined with a power of 7,000 diameters. They may also be seen with lamp or daylight.

Triceratium favus.—The two sets of markings on this fascinating object certainly lie in different focal planes (see Carpenter, "The Microscope," 4th ed., p. 282 and note) and probably "belong to two distinct layers." The coarse hexagonal ridges are found to project from the outer or convex surface, and the inner plate bears the minute markings. This is proved by the fact that the fine markings show decidedly the plainest on valves that are mounted with the interior surface uppermost.

Under this superior objective the finer markings like the larger are distinctly faveolate. Their hexagonal structure is easily seen even with lamp illumination. When examining comparatively thick shells, possessing a complex structure, like the one in question, the necessity for avoiding errors caused by too intense or by excessively oblique light becomes at once apparent. The unequal refraction of the light in passing through the external siliceous layer produces a distorted image upon and of the interior surface. In this manner distorted small hexagons may be seen along the lines of the larger net-work by a lens incapable of clearly displaying the minute hexagonal markings above described.

The best results are obtained on the *T. favus* with a moderate light nearly central.

Surirella gemma.—This beautiful form has been subjected to all the different conditions of illumination in my possession. Like other relatively thick shells the appearances presented by the markings vary greatly with the changing conditions of observation. No trouble is experienced in bringing out the longitudinal striæ, nor in making the little beauty *seem* to "wear beads." At times the beads give place to rectangles, and again after careful manipulation to sharply defined elongated hexagons ("The Microscope," Carpenter, page 182). Hartnack's hexagons as figured are too much elongated; although sometimes such an appearance is presented when the illuminating pencil is at right angles with the median line, the transverse lines being less distinctly perceptible. When the light is so arranged as to show every side with equal perfection the form of the markings is nearer that of regular hexagons.

The Amici prism is found to work excellently on the *Surirella*, and when it is used with the $\frac{1}{50}$ objective and the blue cell the slightly elongated hexagons are easily exhibited on an average frustule.

Aulacodiscus Kittonii.—This splendid disk is traced with easy angular figures evidently elevations and the spaces between the lines are undoubtedly depressions. Some of the markings are circular, others square, some pentagonal, some hexagonal and others heptagonal. Broken specimens of *Brightwellia Johnsonii* with like surface markings show the line of fracture running through the areolæ.

Navicula rhomboides.—Individual frustules of this species vary considerably in degree of difficulty of resolution. Some of the smallest valves when mounted in balsam tax the powers of excellent instruments. The writer has found all specimens whether mounted dry or in balsam to yield readily transverse striæ with oblique illumination direct from the lamp. Under the same conditions an average valve exhibits well defined longitudinal striæ.

With the ammoni-sulphate cell it is instantly and clearly shown covered in every part with squares, like *Pleurosigma Balticum.*

Navicula crassinervis.—The specimens of this variety, in my possession, are more difficult than *Frustulia Saxonica* and even rival *A. pellucida* under lamp illumination, but any clean frustule is satisfactorily resolved.

Using monochromatic light with plain mirror and Wenham's paraboloid, *longitudinal* lines are discovered. After careful manipulation both sets of lines are seen at the same time, and an appearance of beading results.

Navicula cuspidata.—Both sets of lines are easy, but the longitudinal are much closer together than the transverse. Consequently the light interlinear spaces are elongated and no semblance of beading is to be seen. In diatoms where the intersecting striæ are of nearly equal fineness the little square spaces, when not well defined, seem circular, and if the illumination by transmitted light is intense they present a raised appearance due to refraction.

Mr. Charles Stodder called my attention to this diatom with the view of ascertaining with the $\frac{1}{50}$ whether or not the two sets of lines lie in different focal planes. My observations many times repeated have convinced me that they are never both in focus at the same time, and further that the longitudinal lines are on the external surface and the transverse on the internal plate. If there are not two plates the lines may be on opposite surfaces of the same plate.

White cloud illumination is found to be much better than other and more brilliant light for demonstrating these slight differences in focal distances. Many errors of interpretation are avoided by using an approximately central pencil when the instrument used is capable of elucidating all the details of structure without greater obliquity.

Frustulia Saxonica.—In addition to my observation of longitudinal lines upon this test and resolution into dots (NATURALIST, July 1873, page 443) it may be worth noting that even with lamp illumination the $\frac{1}{50}$ has displayed the transverse much clearer than they appear in Dr. Woodward's photo-print. (Lens, vol. i, p. 197.) With oblique light direct from a small German student's lamp, without mirror, prism or condenser of any kind, a person entirely unaccustomed to the microscope could distinctly see them with

Beck No. 3 eye-piece, power 7,000 times. With the ammoni-sulphate of copper cell the longitudinal lines and dots are displayed with ease.

This is one of the most difficult test diatoms thus far studied, ranking but little easier than *A. pellucida*, *N. crassinervis* and *Nitzschia curvula.*

Amphipleura pellucida.—Many times the writer has been able to confirm the observations of longitudinal lines on this most difficult test shell, but never has succeeded in seeing the dots except with the blue cell and Wenham's paraboloid, and only then under favorable circumstances. (See I. E. Smith, in "The Lens," April, 1873, page 115. See also the NATURALIST, May, 1873, page 316.) When resolution is effected, the dots are exceedingly minute and uniform in size, showing as mere points of light when magnified 2500 times. On one occasion the writer has seen fine dark lines crossing between the transverse striæ like the steps of a ladder, the dots or spaces plainly longest in direction parallel with the median line, proving the longitudinal to be finer than the transverse lines.

One obstacle in the way of resolution of the longitudinal striæ is the presence of diffraction lines. The valves being so narrow increases this difficulty. Only after much time is wasted, and after many discouraging failures, will the patient observer receive the reward of success.

Nitzschia curvula Sm.—The unusual number of spurious appearances in this object leads me to suspect that it possesses a complicated structure as yet beyond the reach of the instrument. The extreme fineness of the longitudinal lines as compared with the transverse reminds one of the *Navicula cuspidata*, and as is the case with the coarser shell, no efforts avail to develop a semblance of beading.

Striatella unipunctata.—Two sets of fine lines, and as the direction of the light is changed, may be made to exhibit either beads or squares. In point of value as a test will be found to approach *Surirella gemma.*

Grammatophora.—Of this genus the writer has examined the *G. marina*, *G. subtilissima* and *G. serpentina;* all of which are resolved into hexagons. Broken specimens of *G. marina* show the line of fracture running through the hexagonal planes and leaving points of the net-work projecting. The markings continue completely illustrated as the stage is resolved, in whatever direction the beam of light may fall.

Stauroneis.— Some of the larger varieties of *S. phœnicenteron* are covered with hexagonal areolæ easily exhibited with central daylight. The projecting points of the fractured partitions between the hexagons may be observed.

Pleurosigma angulatum.—Hexagons. The line of fracture generally running around them, but quite often through them.

Pleurosigma Balticum.—A drop of water slowly advancing by capillary attraction shows this shell to be covered with squares, and proves that both sets of lines forming the boundaries of the squares are on the same surface of the valve; and the appearance presented by an air bubble on the other side proves that surface to be smooth.

Pleurosigma formosum.— Near the ends of the frustule it is easy under certain adjustments of the light to make it appear like a checker-board with alternate bright red and green squares. Double rows of green and red beads alternating may be seen on this as well as on other species of the same genus. (Dr. Pigott in M. M. Journal.) When we resort to central light from a white cloud, and thus lessen the liabilities to err caused by refraction, diffraction, decomposition of light, and oblique projection of shadows, the conclusion is arrived at that these various appearances are caused by two sets of intersecting diagonal ridges, the finer ridges running up and down over and between the coarser, and subject to considerable variation even on the same frustule. This theory would also account for the "beads"(?) being of different colors, and the same "beads" changing color when the focus is changed. We see in many of the mollusks shell-markings of a similar character.

Concluding remarks.—It would seem that the perfect box-like form of the shells of the Diatomaceæ and their elaborate ornamentation would exclude the idea of a blind process of chemical crystallization. Analogy should teach that they are secreted for a protective covering for the tender animal-like plant, as among higher forms. If this is true the surface markings ought to be so distributed as to give additional strength to the shell without greatly adding to its weight. It would also be expected that some of the larger shells would be perforated with holes. This idea, of course, would have to admit into the discussion considerations of habits of growth, and environments. Those contained in gelatinous envelopes should be less developed in strength of shell and bracing. Those growing on algæ and in exposed localities should be strong to resist fracture. On those moving free the bracing would be in proportion to the weakness of the shell; larger shells being relatively more liable to be broken. Here as elsewhere nature without waste of material combines utility with beauty.—G. W. MOREHOUSE.

UNMOUNTED OBJECTS.—At the request of a number of microscopists, Mr. Jno. H. Martin, of the Maidstone Micro-assay Laboratory, has decided to establish an agency in this country for the distribution of his well-known unmounted objects. Persons desiring to prepare their own objects can thus obtain a large variety of interesting materials at a very small cost. A stock of objects will be kept for immediate distribution, and articles that may be out of stock furnished as soon as they can be obtained from abroad. Lists and objects can be obtained by addressing, by post, C. A. BALDWIN, *Troy, N. Y.*

NOTES.

A RARE opportunity is offered botanists or scientific institutions of purchasing the cryptogamic herbarium of Dr. Duby (author of Botanicon Gallicum, etc.), containing the cellular cryptogams of all families except the mosses.

This collection contains first, in eighty-five packages, the herbarium of Dr. Wallroth, and includes all the species discovered by this savant and published in his "Cryptogamia Germanica," also that of Nees von Esenbeck, containing the cryptogamic species of the different families (except the lichens and Hepaticæ, which will be mentioned farther on), including a large number of fungi (among others almost all the species of Schweinitz), algæ, etc., etc. Besides these are eighty large packages containing the fungi either gathered or received by himself. Among the number are found the Hypoxyla in perfect order, enriched by authentic specimens from Fries, Montague, Fückel, Berkeley, Currey and Bischoff, perfectly named by them. In these packages are found, among other things, the Lycoperdinei, Hysteria, Uredines, Mucedines, etc., described in his "Botanicon," or other publications. Of exotic fungi the herbarium contains the species